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THE CALCULATION OF WORKMEN'S COMPENSATION PREMIUM RATES

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As there are various agencies for the administering of workmen's compensation insurance, likewise there are varying conceptions of rates. The mutual company desires to return as large a dividend to its assured as possible; so the excess of the rate above adequacy, though a matter of some concern, has not the same bearing upon its calculation as in the case of the stock company; and a similar observation may be made with regard to the state fund, which also desires to return a dividend. Rates now in use by stock companies have been calculated with the idea of simply carrying the business without underwriting loss. It thus becomes necessary to set the limits of this discussion of workmen's compensation insurance rates, and they will be considered in the light of adequacy alone, with no reference to a dividend return.

Insurance is the creation of a fund by means of contributions of comparatively small sums by the many to pay comparatively large amounts of indemnity to the few. This is insurance in its broadest conception, and the contrast between the many who escape disaster and the few to whom it comes is narrowed in the case of workmen's compensation, because a large number of accidents are constantly occurring which individually occasion small payments, but which are heavy in the aggregate. Serious accidents causing death or permanent disability with heavy payments of indemnity are not so frequent as the slight accidents just mentioned, and occur to comparatively few of the employers contributing to the fund, but they too are heavy in the aggregate. It is against these serious accidents that an insurance system most aptly applies.

In order to establish a fund, contributions are secured in the form of premiums; and premiums are calculated by taking a unit of exposure to risk, multiplying that unit by the rate, and then multiplying the product so obtained by the number of units of exposure.

The theoretical exposure is the number of men working during a year reduced to the equivalent of the number of men working a standard number of working days during a year at a standard number of hours per working day. The practical exposure, and the one used, is the pay-roll of those men for a year. The pay-roll basis approximates the theoretical basis, and clears away the difficulty of men not working a full year or working at part time during portions thereof. If we can approximate the yearly wage of a man working a whole year, the number of men working a whole year can be obtained by dividing the total yearly pay-roll by the average yearly wage of one man. If the pay roll is \$1,000,000 and the average yearly wage \$600, the equivalent number of men exposed to risk for a year is $1,000,000 \div 600 = 1,667$.

The practical exposure being the yearly pay-roll of an employer, a practical unit of exposure must be adopted, and this is \$100 of pay-roll. The ratio of the benefits paid injured workmen or their dependents to the number of one-hundred-dollar units of pay-roll is the basis of workmen's compensation rates, and is called the "pure premium." It is that rate per \$100 of yearly pay-roll which would be charged after all corrections had been applied, were there no expenses in the administration of the business. These corrections will be considered later.

As accidents vary in frequency and seriousness among employers in different lines of business it would be unfair to determine "pure premiums" for all pay-rolls of all classifications of employers combined. A generally recognized standard list¹ of industrial classifications, about 1,500 in number, has been made, and rates for each of these classifications have been determined.

In order to determine as dependable pure premiums as possible it becomes necessary to secure the largest possible experience upon individual industrial classifications. It is unnecessary to enlarge upon or to illustrate the proposition that the larger the exposure to risk the more dependable the average pure premium per unit of exposure (\$100 of pay-roll). The work of the National Workmen's Compensation Service Bureau, composed of about twenty stock companies administering workmen's compensation insurance, is probably the best example of the calculation of pure premiums by

¹ See *Standard Manual of National Workmen's Compensation Service Bureau*, 13 Park Row, New York City.

reason of its being in possession of more workmen's compensation statistics (and all on a uniform basis) than any other organization. The companies comprising the bureau have for several years been reporting their statistics. These have been reported by states, within states by years of issue of policies, within such issues by manual industrial classifications, and within manual classifications, among other variations, by kind of benefit paid to injured workmen. To these statistics reported by the companies to the bureau has been added such additional experience collected by the insurance departments and industrial accident boards of various states as was on a basis uniform with the bureau's experience, and it is a matter of congratulation that the methods of the state bodies and the bureau in the matter of statistics have in a number of instances been practically uniform. The bureau being in possession of this experience has combined it by states, within states by year of issue, within years of issue by manual industrial classification, etc., thus producing as extensive and dependable experience as can be found. In such combinations corrections have been made to take care of varying cost of the workmen's compensation laws of the different states, so that all may be upon a known level.

Experience in the United States is in general tabulated upon a policy year of issue basis. This means that all policies issued, say in 1915, are considered as belonging to the 1915 unit. A policy issued in January, 1915, will expire in January, 1916, one issued in June, 1915, will expire in June, 1916, etc., so that the last policy to expire in 1916 on 1915 issues will be one issued on December 31, 1915. The indemnity and medical payments covered by these policies, when made, are ticketed with a 1915 issue mark, so that whenever, even during a long period of years, a payment is made on an accident covered by a 1915 policy it will be referred to the 1915 issue. The same procedure is adopted with payments incurred but not yet made on such accidents, commonly known as outstanding medical or indemnity. The pay-rolls on these policies are ticketed in a similar manner.

Thus a basis is established for computing rates that will take care of all medical and indemnity payments incurred during the year for which a policy is issued, so that when an employer pays his premium on a policy he knows it will cover all indemnity and medical aid for all accidents occurring during the period the policy covers. His premium for that year is a part of his business expenses and he

knows that there will be no assessments for accidents occurring during that year to be paid for by him at a later date.

This year of issue basis also enables comparison of the experience of one year of issue with another, thus establishing whether the cost of compensation is rising or remaining level.

After all of this experience has been combined and reduced to a common level by means of appropriate factors, the medical and indemnity benefits, paid and outstanding for the individual manual classifications are divided by the number of \$100 units in the payroll exposure for those classifications, thus producing a basic pure premium for each classification. Despite the fact that a great volume of experience is in the possession of the bureau, it may be that on certain classifications there is, and can be, but little experience. The experience on such classifications is carefully studied in its relationship to similar classifications having dependable experience, and pure premiums decided upon. The whole experience is then checked up to see that these judgment pure premiums are in all probability correct, and the basic pure premiums are released for rate-making purposes.

It now becomes necessary to determine whether outstanding benefits² have been adequately given in the experience and, if not, to establish a correction factor to take care of the inadequacy. This is done by checking up the experience on outstanding losses in the past. If it be found that a factor is necessary, such a factor is decided upon. It will be a decimal which we shall call *k*.

Because the compensation laws in the various states differ in their provisions, a series of values or differentials must be established which will measure the cost of all laws in comparison with a law adopted as a base. The base adopted is the original Massachusetts compensation law. In order to arrive at these law differentials a standard table of accidents distributed according to seriousness, constructed by Dr. I. M. Rubinow and published by the Spectator Company of New York City, is assumed to apply to every state and to every industrial classification. The cost of the law in each state for these accidents is worked out upon a basis of weeks' wages. The medical cost expressed in weeks' wages and determined from actual experience wherever possible is included. By dividing such cost for each state by the cost for the basis state a

² Benefits which it will be necessary to pay but which have not become due.

series of law differentials is obtained. Knowing the common level of the combined basis premiums as far as the law cost is concerned, the basis pure premium is multiplied by the ratio of the law cost for the state for which the rate is sought to the law cost in the combined experience. This will be a factor which we shall call *l*.

An objection to this method may be raised because different industries produce different distributions of accidents. This is quite true, but no statistics can be obtained which will determine these varying distributions, and as the factor is a ratio anyway, the effect of different distributions will be to produce different ratios which may not be much at variance with each other. Until a new table is compiled or distributions obtained for various industries it is felt that the above method is the best that can be used.

Another consideration is that of varying accident frequency between states.³ Do accidents occur more frequently in one state than another, and if so, do all accidents, serious and non-serious, vary to the same degree? If so, a factor to correct for this should be applied, which we shall call *a*.

The study of compensation experience shows that as a compensation law grows older the cost of compensation increases. This has been ascribed to the education of the workmen as to the law and his right to benefits thereunder, and to an increasingly liberal construction of the law by the courts and industrial accident boards or commissions. So a factor must be applied to take care of this which we shall call *i*.

In issuing compensation policies variations in the manual rates, which are average rates, are allowed after an inspection of the plant of an employer or a study of the accident experience of his plant. These are known as schedule variations in rates, when inspections determine such variations, and experience variations when the determination is upon the accident record. Rates are increased or decreased upon individual plants upon these bases and it has been found in the past that the increases and decreases in rates did not offset each other in the combined experience so as to reproduce an average rate. This effect of Schedule and Experience rating must be taken care of by a factor which we shall call *s*.

³ See *Synthesis of Rates for Workmen's Compensation*, p. 12. C. E. Scattergood. Published by the Fidelity & Casualty Company, 92 Liberty St., New York.

Some compensation laws may specifically cover industrial diseases and others have been construed to cover them. In such cases a factor for industrial disease must be introduced, which we shall call d .⁴

If the insurance carrier thinks that by reason of his service in administering the compensation fund he is entitled to a small profit, a loading for profit may be added, which we shall call p .

We now have:—

Basis Pure Premium	
Underestimate of Outstanding Benefit Factor	k
Law Cost Factor	l
Accident Frequency Factor	a
Increasing Cost Factor	i
Schedule and Experience Rating Factor	s
Industrial Disease Factor	d
Profit Factor (if used)	p

Applying these factors to the basic pure premiums we have as the pure cost, without expenses, for a given state:

$$(\text{Basic Pure Prem.}) (1+k) (1+l) (1+a) (1+i) (1+s) (1+d) (1+p)$$

In general k , l , a , i , s , d , and p are fractional, so that the quantities in the parentheses are each greater than unity, but conditions may arise where a quantity in parentheses may be less than unity, as for instance, in the case of accident frequency.

So far we have considered the pure medical and indemnity cost of compensation, but this is only a part of a rate. Expenses must be incurred in administering this fund:—claim expenses, taxes, rent, stationery, etc.; acquisition of business expense, inspection expense, administration expense. The ratio of expense to rate will not be so high in a state which gives high compensation benefits as in a state where low benefits are given by the law. Therefore the percentage loading of the rate for expenses for a state with high benefits will be less than for one with low benefits. A series of loadings for expenses has been calculated with this feature in mind. Let eh represent the expense per cent of the rate in a state with high benefits and em the expense per cent in a state with low benefits, and er the loading for a state with medium benefits. If eh , em , or er , as the case may be, is the expense per cent, then $1 - eh$, or $1 - em$, or $1 - er$ is the per cent of rate for compensation medical and indemnity benefits and this

⁴ A consideration of this feature is too long for this article and the reader is referred to a pamphlet by the writer, *Synthesis of Rates for Workmen's Compensation*, p. 17, published by the Fidelity & Casualty Company of New York.

percentage is the pure cost per \$100 of pay roll. Then the pure cost divided by $1 - eh$, $1 - em$, or $1 - er$ will give the rate including expenses. Expressed in formula:—

For states with high benefits Rate=

$$\frac{\text{(Basic Pure Prem.) } (1+k) (1+l) (1+a) (1+i) (1+s) (1+d) (1+p)}{1 - eh}$$

For states with low benefits Rate= $\frac{\text{Numerator as above}}{1 - em}$

For states with intermediate benefits Rate= $\frac{\text{Numerator as above}}{1 - er}$

If for any reason it is expected that during the period for which rates are calculated conditions other than those already taken care of will arise which will tend to increase or decrease the cost as shown by the experience upon which the pure cost is calculated, a factor $(1+x)$ should be included in the numerator which will be greater or less than unity as the case may be. As a case in point, note increased number and severity of accidents due to abnormal industrial activity during the European war.

If it be argued that the expense factor is too large in any case, it should be noted that claim adjusting expenses could very well be referred to the numerator as a loading upon the Basic Pure Premium, because these may be considered as part of the pure cost. It should also be observed that a carrier has no control over the part of the loading charged for taxes and fees to the state. If these items be transferred to the numerator the expense loading is lessened.

In the study of workmen's compensation a clear cut recognition of the expenses in connection with the administration thereof should be made. Expenses should be analyzed according to adequate definitions and charged under a correct system of accounting. Otherwise how can one system of administration be compared with another; or how can an insurance company transacting multiple lines of business know that each line of business is bearing its proper expenses? There is this difference between the medical and indemnity disbursements of an insurance carrier and the expense disbursements: the medical and indemnity are paid to or in behalf of injured workmen under provisions of law and are easily recognized, while the expense payments include those which may be assigned to specific claims and also that great, hazy mass of overhead charges such as rent, stationery, light, postage, telephone, telegraph, express,

etc., which are not without considerable study and care assigned in proper portions where they belong.⁵

It has just been remarked that medical payments in behalf of injured workmen are easily recognized, but a situation presents itself where this classification of disbursement is not so readily discerned. Suppose an insurance carrier employs physicians to administer medical relief and while doing this to settle claims. Shall the expense of such agents be charged as a *medical disbursement* to the injured or as a *claim expense* to the company, or should such disbursement be divided in some proportion between medical to the injured and claim to the carrier. How can the administration of different insurance carriers be compared when three different companies may each classify this kind of disbursement in a different manner? This is just one case for purpose of illustration.

It is submitted that no comparison between insurance carriers can be made until their accounts are placed *on exactly the same basis* in every particular, and that everything be analytically accounted for and audited by the same disinterested parties.

One more item remains to be considered and as this is a flat charge upon pay-roll independent of rate, the calculation of the rate has been considered first. This is the catastrophe rate added to care for extraordinary losses. This rate does not vary with the pure premium and is regarded as an addition to the rate itself. Let us call it *c*, which represents an amount of *c* per \$100 of pay-roll. We now have:—

Rate for high benefit state=

$$\frac{(\text{Basic Pure Prem.})(1+k)(1+l)(1+a)(1+i)(1+s)(1+d)(1+p)}{1-eh} + c$$

It may by this time be agreed that enduring in the race for carrying compensation insurance depends upon careful observation of the subject in all of its aspects and details. Appropriations for adequate scientific actuarial and statistical research work into this comprehensive and important subject are items in the budget of the insurance carrier the neglect of which is likely to be followed by disastrous consequences. The success of the insurer depends on accurate rates; and accurate rates can be computed only by trained scientists working with adequate modern equipment.

⁵ See "Cost Accounting in Casualty Insurance," C. E. Scattergood. Published by the author in pamphlet and appearing in "Proceedings No. 5" of *Casualty Actuarial and Statistical Society of America*.